Thumb Pain in Physiotherapists: Potential Risk Factors and Proposed Prevention Strategies

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Abstract: Work-related injury to the thumb has become a recognized problem for physiotherapists who perform manual techniques in the treatment of patients with orthopaedic musculoskeletal disorders. Pain in the thumb often causes physiotherapists to alter their methods of treatment, which may decrease the effectiveness of physiotherapy services and lead to increased financial costs for patients and their funding agencies. Substantial numbers of physiotherapists have changed their specialty area or left the profession because of work-related injury, which further burdens education and healthcare systems. The extent of the influence of individual risk factors and preventive strategies on the development of thumb pain in physiotherapists has not been conclusively determined. This paper discusses the potential causes and consequences of thumb pain in physiotherapists, and reviews the supporting evidence on the incidence, risk, prevention, and treatment of this common occupational injury in physiotherapists.

Key Words: Thumb, Pain, Work-Related Injury, Physiotherapist

The prevention of work-related injury in healthcare providers has become a high priority due to increased emphasis on cost effectiveness in the delivery of healthcare services. This awareness of the need to address occupational injury has become apparent in the profession of physiotherapy[1]. It has been reported that one in six physiotherapists moves within or leaves the profession because of a work-related musculoskeletal disorder; in fact, 91% of physiotherapists in one survey reported work-related musculoskeletal discomfort sometime during their working life.[2] This survey did not include those whose physiotherapy registration had lapsed, so these figures may even underestimate the problem. The loss of physiotherapists from the workforce likely places a financial burden on the community, including the education system that trains physiotherapists, the health care system, which may have difficulty retaining physiotherapists, and the physiotherapists themselves who may have suffered personal costs.

The prevention of work-related injury in physiotherapists should include a particular emphasis on the hand and thumb, since maintaining effective use of the hand as a treatment tool for administering manual techniques is important for the physiotherapist, and the hand, wrist and thumb are commonly reported as sites of work-related injury by physiotherapists[2-5]. Three recent studies have found the hand to be the second most common anatomical site of work-related injury for physiotherapists, following the low back[3-5]. Work-related injury to the hand/wrist complex is also the second most common condition for which physiotherapists seek treatment from a physician[3]. Despite these findings, there has been very little research into the causes of specific thumb and hand

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disorders in physiotherapists. In particular, an extensive literature search of the Medline and CINAHL databases uncovered only two published surveys of physiotherapists that listed thumb pain as a separate injury from other disorders of the hand. This paper presents some possible causes and potential prevention strategies for thumb pain in physiotherapists based on the available evidence, and it poses questions for discussion and further research.

The Influence of Manual Therapy

Administering manual treatment using the hands has been an important part of physiotherapy since its outset; many traditional texts by authors such as Maitland et al, Cyriax, and Kaltenborn have focused primarily on the administration of manual techniques for the treatment of musculoskeletal disorders[6-8]. Manual therapy techniques that require the use of the thumb, such as mobilization or manipulation, are often used for treating spinal pain, one of the most common conditions managed by physiotherapists working with orthopaedic musculoskeletal disorders[9]. New approaches to the treatment of orthopaedic disorders, such as the techniques made popular by Brian Mulligan, also require extensive use of the thumb for the application of the techniques[10]. It is likely that manual techniques will continue to be used by the physiotherapist as the body of research supporting the efficacy of manual therapy and manipulation continues to grow.

Systematic literature reviews indicate some evidence that mobilization and manipulation are effective in the treatment of low back pain, neck pain, and headaches[11-13]. Hurwitz et al reviewed 509 studies relating to the cervical spine or headaches and concluded that mobilization provides at least short-term benefit for patients with acute neck pain, and both mobilization and manipulation may be beneficial for muscle tension headache and are likely superior to usual general practitioner care for subacute or chronic neck pain[11]. In another systematic review of 150 randomized controlled trials investigating low back pain treatments, the authors concluded that there was moderate evidence that manipulation was more effective for chronic low back pain than physician management, bed-rest, analgesics, and massage, and strong evidence that manipulation was more effective than a placebo in chronic low back pain[13]. One randomized multi-clinic trial on 256 patients with non-specific back and neck complaints was able to effectively demonstrate support for the efficacy of manual therapy. Their results indicated that physiotherapy (exercise, modalities, and massage) and manual therapy (mobilization and manipulation) were more effective than physician management and placebo treatment in decreasing the severity of complaints at 3, 6, and 12 weeks follow-up. At 12 months follow-up, the manual therapy group showed greater improvement in their main complaint and in physical functioning than the group that received physiotherapy[14-15].

Thumb Forces and Repetition

The application of many manual techniques, including mobilization, manipulation, and massage, requires practitioner-generated hand forces; often these forces are transmitted specifically through the thumb to the patient. When force is transmitted through the thumb, contact pressures within the thumb joints may be quite significant, since the therapist usually generates forces using her body weight, while the distal end of the thumb is met by the resistance of the tissues being treated[16]. Thus, the thumb is being used as a pseudo-weight-bearing joint, a function for which it is not designed. Continual repetition of manual techniques that require force transmission through the thumbs over years of physiotherapy practice may lead to osteoarthritic degenerative changes in the joints of the thumb and repetitive strain injury. In fact, the prevalence of thumb pain has been reported to be 60% in physiotherapists who regularly administer manual techniques[2]. In another survey, the application of manual techniques was the main factor that contributed to the onset of thumb pain for 88% of manipulative physiotherapists who experienced symptoms in the thumb[17]. These findings suggest that of all the structures in the hand, the thumb joints are particularly vulnerable to biomechanical overload in physiotherapists who regularly use manual techniques.

The cumulative effect of forces through the repetition of manual techniques may also contribute to the development of thumb symptoms and joint pathology. Maitland et al describes many techniques involving the use of the thumb pad to apply pressure, recommending 3 to 4 sets of 30-second mobilizations for a therapeutic application to one joint, with the frequency of thumb pressure ranging from 1 oscillation every two seconds to 2-3 oscillations per second[6]. It is likely that a treatment session could include mobilization to several joints, which may lead to even further repetition of forceful movements with the thumb. Exposure to forceful and repetitive work has been linked to the development of musculoskeletal disorders in the hand, as evidenced by a review of epidemiological studies examining the relationships between occupation and upper-limb disorders in industries such as meat packing, manufacturing, automotive assembly, and others[18]. Consistent with this report is the finding that physiotherapists who perform manual therapy techniques more than 20 hours per week are 3.5 times more likely (95% CI=2.54-4.79) to have musculoskeletal pain symptoms in the hand or wrist than other physiotherapists[3]. This follows, since those physiotherapists who perform more manual techniques would have a greater exposure to activities that require increased repetition and force.

Effects on the Workplace

Following injury, physiotherapists have a tendency to continue to work, and most commonly use modification of their treatment techniques as a coping mechanism[2-5][Table 1]. This is particularly true for physiotherapists who suffer from disorders of the thumb joints. In one study, 91% of physiotherapists with thumb pain reported they had to modify their treatment techniques because of pain in the thumb[5]. However, only about 3% of physiotherapists with any type of hand disorder report missing work due to their symptoms[3, 16]. Altered methods of treatment may decrease the effectiveness of the delivery of physiotherapy services and lead to increased financial and personal costs for patients and their funding agencies. Therefore, there is a particular need to investigate the causes of musculoskeletal thumb pain in physiotherapists and to develop intervention programs to prevent occupational injury to the thumb.

Potential Risk Factors

A discussion of the possible reasons why physiotherapists develop thumb pain must consider many potential contributing factors. These factors can be categorized into intrinsic factors, technical factors, and environmental factors.

Intrinsic Factors

Intrinsic factors relate to the inherent physical attributes possessed by the physiotherapist, in particular the state of the hand as a treatment tool. Is the hand inherently large or small, strong or weak, stiff or mobile? Intrinsic factors may predispose an individual to the development of thumb pain from the stresses incurred in their work as a physiotherapist. Intrinsic factors include the joint integrity of the thumb, the strength in the hand and forearm, the general size of the hand, as well as the general size of the therapist.

Joint Integrity

Joint integrity has many influences, including the quality of capsular tissue, the forces that are imposed upon the joints during manual therapy, the osseous configuration of the joint surfaces, the specific mobility at each thumb joint, and the position of attachment of the stabilizing ligaments.

Capsular laxity

Individuals with a genetic predisposition to hypermobility, or excessive capsular laxity, are believed to be at increased risk for the development of early osteoarthritis[19-21]. This is particularly true of the thumb carpometacarpal (CMC) joint, the joint formed by the base of the first metacarpal and the trapezium bone in the wrist[22]. A causal relationship has been determined between generalized articular hypermobility and the development of osteoarthritis in the CMC joint of the thumb. A study in Iceland with 50 patients and 94 controls found that patients with osteoarthritis predominantly in the first CMC joint were more likely to show signs of generalized joint hypermobility than the normal population[23].

The amount of laxity that the first CMC joint is able to tolerate over a lifetime is influenced by the forces imposed upon the joint[24]. Occupations or hobbies that impose excessive force over time will contribute to increased or early degeneration of the joint surfaces. Ultimately, 1 in 4 women and 1 in 12 men will develop radiological evidence of osteoarthritis at the thumb base[24]. It is important to note that radiological evidence of CMC joint arthritis in the thumb does not necessarily mean the thumb will be symptomatic[24]. Often, symptoms will be unilateral when radiological findings are positive for joint disease bilaterally[25-26]. However, the degree of osteoarthritis visible on radiograph is often the primary determinant for categorizing the severity of joint degeneration, and radiological findings are used to guide medical intervention of painful thumb symptoms[24-28]. One study, which examined the radiographs of 143 post-menopausal women presenting with acute distal radial fractures, was able to demonstrate a statistically significant relationship between the grade of thumb CMC joint osteoarthritis and the presence of basal thumb pain[29]. This lends some support to the relationship between radiographic evidence of joint degeneration and pain. Although not confirmed radiologically, the trend in physiotherapists appears to be of an increased likelihood of degenerative changes in the thumb at an earlier age than would be expected, based on the number of therapists reporting thumb pain and their ages[5].

Osseous configuration

The CMC joint of the thumb is often described as a saddle joint because of the shape of the articular surface of the trapezium[30-31]. The articulating surfaces of the trapezium and first metacarpal are incongruously matched, which limits the surface area that is available to transmit a load across the joint and increases the contact stress where small areas of the joint surfaces do articulate[26]. This osseous configuration allows for maximum mobility for intricate hand function but provides little bony constraint[24, 26, 32]. Therefore, the thumb CMC joint relies heavily on ligamentous and muscular restraints to control joint stability. This situation is made worse by the presence of hypermobility, in which excessive auxiliary movement in the joint accelerates degenerative change, leading to further asymmetry in the contact area between the joint surfaces and a subsequent increase in the CMC joint contact pressure[31].

Table 1: Summary of surveys of physiotherapists regarding their work-related thumb injuries.

	West & Gardner (2001)[5]	Cromie et al. (2000)[2]	Holder et al. (1999)[4]	Bork et al. (1996)[3]	Neville & Rivett (1985)[17]	Balon (1984)[16]
Number of physiotherapists surveyed	217	536	370	928	81	46
Response rate	53%	67.9%	74%	80%	85%	87%
Specialties surveyed	All	All	All	All	Manip. therapists only*	Manip. therapists only*
Data time frame	Career	Career	Last 2 years	Last 12 months	Career	Career
Location	rural Queensland	Victoria, Australia	Most states in USA	Most states in USA	NSW, Australia	Victoria, Australia
Prevalence of thumb injury	20% - 46%	33.6% (last 12 months)	7.3% (includes wrist & hand)	29.6% (includes wrist & hand)	81%	70%
Of all physiotherapists reporting thumb pain, incidence of symptoms in:						
CMC joint	67%† (includes carpal joints)	–	–	–	57%	41%
MCP joint	72%†	–	–	–	70%	50%
IP joint	26%†	–	–	–	31%	28%
% reporting manual therapy problematic‡	82% (of 61 hand injured)	53.8% (of 377 to whom the risk was relevant)	28% (of 119 with work-related injury)	12% (of all 928 surveyed)	97% (of 66 thumb injured)	–
% of hand or thumb injured who altered their manual techniques due to injury	91%	–	–	22%	At least 59%	43%

*Manipulative therapists are physiotherapists who have completed formal post-graduate training in manual therapy and who work primarily with outpatient musculoskeletal disorders.
†Percentage calculated from all physiotherapists with hand injuries, rather than only those with thumb injuries.
‡Population reported varied among the different surveys.

Women tend to have a more shallow trapezium saddle than men,[26, 31] which contributes to decreased congruence of the articulating surfaces and consequently less osseous stability, resulting in a greater reliance on soft-tissue restraints. Women are also more prone to an increase in soft-tissue laxity following menopause,[31] further contributing to instability at the thumb CMC joint and a greater risk of developing CMC joint arthritis. Post-menopausal women are 10 to 20 times more likely to develop thumb CMC joint arthritis than their male counterparts[26]. In the physiotherapy profession, women generally outnumber men. For example, of the 5444 therapists registered in NSW, Australia in 1999, 78% were female[33]. Because of the predominance of female physiotherapists and the demonstrated link between the occupational demands on the physiotherapist's thumb and the development of work-related thumb pain, the risk of developing thumb CMC joint arthritis in physiotherapists can be considered quite high.

Specific thumb joint mobility

The two other joints of the thumb, the metacarpophalangeal (MCP) joint and the interphalangeal (IP) joint, may also contribute to thumb pain in physiotherapists. The mobility at both of these joints can influence the overall function of the thumb as a treatment tool for administering manual therapy. Adequate mobility into extension at the IP joint helps the therapist place the pad of the thumb on the patient while positioning the rest of the thumb vertically over the IP joint for the application of pressure. If a physiotherapist lacks IP extension, the base of the thumb will be positioned further away from the point of contact when the thumb pad is used for applying pressure. When the therapist applies pressure through the thumbs with the joints positioned in this way, the joint compressive forces are greater in the first CMC and MCP joints because the moment arms for the inertial forces through these joints increase[16](Figure 1). Increased joint compressive forces during the application of manual techniques over time may lead to premature degeneration of the joint surfaces and painful symptoms for physiotherapists.

Excessive mobility at the MCP joint can be detrimental for the physiotherapist, since MCP hyperextension may contribute to the development of degenerative changes in the thumb CMC joint. MCP hyperextension causes a dorsoradial shift of the base of the first metacarpal, as the distal end of the metacarpal is pulled toward the second metacarpal shaft. This dorsoradial shift of the base of the first metacarpal represents the instability that can accelerate degenerative change in the thumb CMC joint and cause painful symptoms[24-26, 28, 34]. Manual techniques that use the thumb for the application of pressure can impose forces on the MCP joint that encourage it to hyperextend (Figure 2), potentially contributing to degenerative changes in both the MCP and CMC joints.

Stabilizing ligaments

As degenerative change progresses in the thumb CMC joint, the wearing away of articular surfaces causes a migration of the distal attachment of the stabilizing ligament on the anterior surface of the CMC joint, the anterior oblique ligament[25]. This ligament loses its efficiency as a joint stabilizer, while the strong pull of the adductor pollicis muscle, which tethers the first metacarpal shaft

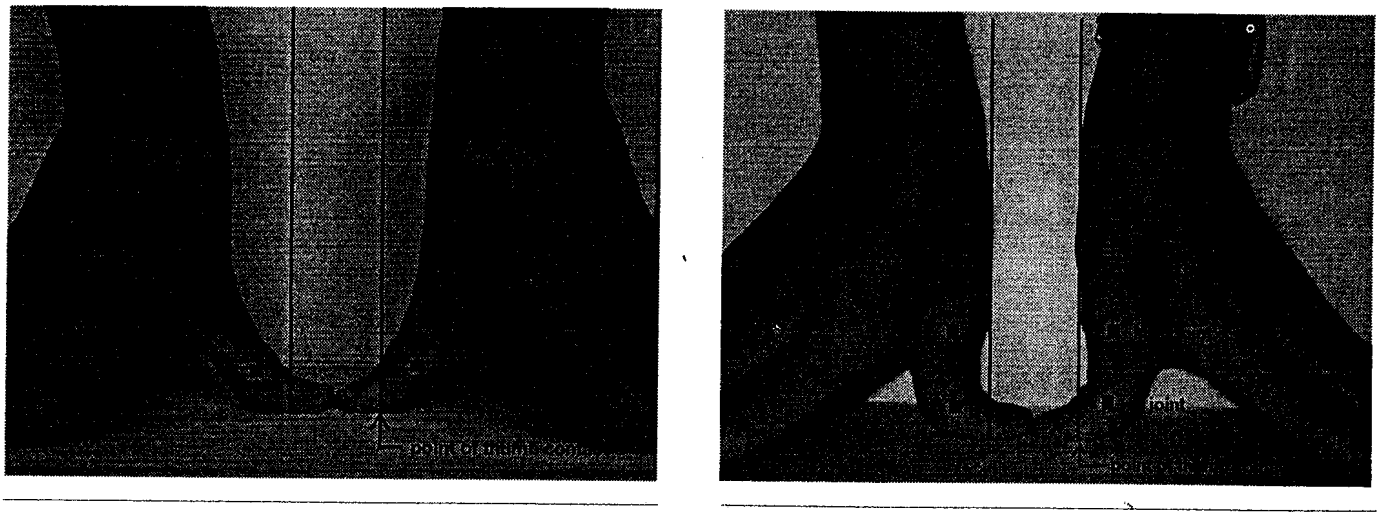

*Fig. 1: Two thumb positions commonly used for mobilizing a spinal joint. **Left:** The center of the thumb CMC and MCP joints are positioned further from a vertical line drawn through the point of thumb contact, potentially leading to greater joint compressive forces between the articulating surfaces of those joints. **Right:** The MCP and CMC joints are better aligned with the point of contact and may not be subjected to as much joint stress.*

and distal end to the second and third metacarpals, creates further instability at the CMC joint[34]. As the CMC joint becomes less stable and the base of the metacarpal migrates dorsoradially, the head of the metacarpal shifts palmarward, resulting in MCP hyperextension. Therefore, it could be said that degenerative change at the thumb CMC joint can cause the MCP joint to hyperextend, in addition to MCP joint hyperextension contributing to degenerative change at the CMC joint. Clinically, it has been observed that as CMC joint arthritis progresses, MCP joint hyperextension becomes more evident[24-26, 34-35].

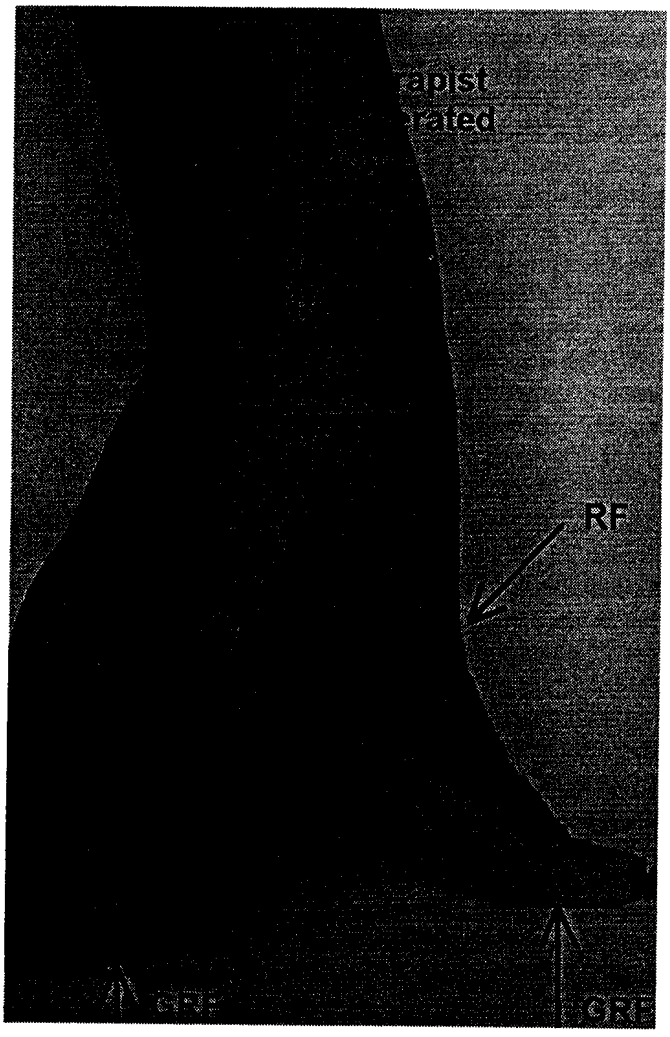

Fig. 2: Downward force generated through the upper limb of the physiotherapist may result in forces that push the MCP joint into hyperextension, potentially leading to dorsoradial subluxation of the CMC joint and pain at both the MCP and CMC joints. GRF: Ground reaction force generated by the resistance from the patient's tissues, which directs force back to the therapist. RF: Resultant force encouraging the MCP joint to hyperextend.

Effects on the physiotherapist

The joint stresses involved in the repetitive application of forces while administering manual techniques may contribute to the deterioration of both the MCP and CMC joints of the thumb since each joint influences the other. Out of 61 physiotherapists in a recent survey who had hand symptoms, 72% complained of symptoms in the first MCP joint and 67% in the carpal joints, which included the first CMC joint[5]. However, the 217 physical therapists in this survey only represented a 53% response rate, and since the thumb CMC joint was combined with the carpal joints, the extent of complaints specifically at the CMC joint is unknown. Two other surveys have found a similar prevalence of thumb MCP and CMC complaints in physiotherapists with thumb pain, about 60% for MCP joint symptoms and 50% for CMC joint symptoms [Table 1][16-17]. Complaints of IP joint symptoms are much less frequent, with the prevalence of pain in the IP joint approximately 27%[5, 16-17]. In all three surveys, respondents were allowed to choose more than one problematic joint, which explains the high percentages of complaints at each joint, and demonstrates that physiotherapists with thumb pain commonly have problems in more than one joint. For the CMC and MCP joints, this may be because the positions of the two joints influence each other, as their articulations are located at either end of the first metacarpal bone.

Strength

In addition to joint integrity, the strength of the muscles in the hand and forearm may be another intrinsic factor that contributes to thumb pain in physiotherapists. It has been postulated that the abductor pollicis longus and the extensor pollicis brevis muscles assist in stabilizing the CMC joint because of their angle of pull and insertions on the first metacarpal[32, 36]. Since the CMC joint has very little osseous stability and only average ligamentous stability, the importance of muscles as stabilizers for the joint must be considered. Most of the muscles that cross the thumb CMC joint pull the first metacarpal toward the palm for the functions of grip and pinch[37]. The only muscles that are positioned to pull the thumb away from the palm are the abductor pollicis longus, the extensor pollicis brevis and longus, and to a lesser degree the abductor pollicis brevis. The abductor pollicis longus is best positioned to help stabilize the thumb CMC joint with its deep divisions inserting into the capsular restraints on the anterior and radial surfaces of the CMC joint[32]. Exercises to strengthen these muscles and enhance thumb extension and reposition (the reverse of opposition) have been recommended to help prevent the progression of CMC joint instability and degenerative arthritis[26, 38]. These exercises could also potentially slow the progression of painful thumb symptoms in the physiotherapist.

Size

The size and bulk of the hand and physiotherapist may have an influence on the amount of strength that is available for the application of force during manual techniques. It is reasonable to hypothesize that a large male therapist may be able to apply manual techniques with greater force. The relationship between the amount of force applied by a physiotherapist and their physical attributes has not been explored. However, several studies have demonstrated extreme variability between the forces that are applied by different physiotherapists performing the same manual technique[39-41].

The relative influence of joint integrity, hand and body size, and strength on the degeneration and pain in thumb joints of physiotherapists is not known. Questions also remain as to whether exercise, interventions to increase stability such as splinting, or changes in manual therapy hand positions may help prevent or delay the onset of degenerative changes in the thumb of the physiotherapist.

Technical Factors

Technical factors pertain to the way a physiotherapist uses her hands to administer manual therapy treatment. Manual therapy techniques such as mobilization, manipulation, and massage require significant input from the therapist's hands, along with practitioner-generated forces and the therapist's body weight. Techniques that use the tip or pad of the thumb to apply pressure cause strong forces to be transmitted through the thumb joints from the physiotherapist to the patient. Some examples of these techniques include a posterior-to-anterior spinal mobilization applied with the thumb as described by Maitland et al,[6] massage techniques in which the thumb slides along the length of a muscle,[42] and trigger point work where the thumb is used to place specific pressure on a point of maximal muscle tightness[43].

Physiotherapists use a variety of techniques to administer manual treatment, depending on the age and condition of the patient, the area being treated, and the experience and training of the therapist. The technical aspects of the delivery of each technique may differ in several ways: the amount of force that is applied, the frequency at which it is applied, the length of time it is applied, and the joint angle that results from the position of the hand used to apply the force. The effect of these technical parameters on the health of the hand and thumb of the physiotherapist is not known.

Force

The thumb is often used to apply pressure in manual therapy techniques for the spine and, to a lesser degree, the extremities. This commonly causes forces to be repetitively transmitted across the thumb joints, which can lead to degenerative change in the involved joints and repetitive strain injury[16-17, 44]. The amount of force that a physiotherapist may regularly apply with the thumbs when treating symptomatic patients is unknown. However, one research study has been published on the levels of force physiotherapists use when performing posterior-to-anterior spinal mobilizations using their choice of hand position, either applying force through both thumbs, or through the ulnar side of the hand near the pisiform bone[39]. In this study, a spinal model was used to simulate a single segment of the human spine, and average forces were calculated at three levels of stiffness by having physiotherapists perform different grades of mobilization on the model, using standardized methods based on techniques described by Maitland et al[6]. Mean peak forces across grades and stiffness levels varied tremendously between physiotherapists, ranging between 57.59 N and 178.27 N[39]. It was not reported which hand position was used in each condition or by each therapist, or whether the hand position could have affected the force applied, so conclusions cannot be drawn specifically for forces applied by the thumbs. However, it is clear that there is extreme variability in the forces applied by different therapists, and some therapists are regularly generating substantial forces in the application of manual techniques.

Frequency

In addition to force, the frequency or rate of oscillation of the thumb pressures applied during manual therapy may also have an effect on the stress and strain on the thumb joints. An increased frequency of oscillation may increase the cumulative effect of force on the joints, since a greater number of thumb oscillations could be applied during a specific length of time, as compared to a slower frequency. The cumulative effect of force would increase if the holding time of thumb pressures remained the same while the rest time between pressures decreased during a specific period of time. The length of time that a technique is applied may also contribute to increased forces on the thumb joints. The cumulative effect of forces on the thumb may be further influenced by the total number of treatments performed during the course of a day, a week, or a career. An increase in frequency or length of time that a technique is applied can result in increased repetition of forces applied to the thumb joints. Repetition of forces in the workplace has been linked to degenerative change and repetitive strain injury,[18, 44-45] although this has not been investigated with respect to the repetition of forces in manual therapy.

Repetition

Continual repetition of forces over years of physio-

therapy practice would be expected to result in cumulative trauma that would contribute to joint pain, but surveys of work-place injury in the physiotherapy profession have not supported this hypothesis. In fact, surveys of 928 physiotherapists in the US and 536 physiotherapists in Australia have agreed that with increasing age, physiotherapists are less likely to report problems with musculoskeletal symptoms. Decreased prevalence of musculoskeletal injury in older physiotherapists may be due to survivor bias, or the transition of older physiotherapists into less physically demanding work, such as administration or academia[2-3]. Physiotherapists may also have altered their manual techniques over years of practice to accommodate for any joint symptoms they may have experienced[5]. Further research is needed in order to draw conclusions about the relationships between frequency, force, and time, and the development of degenerative changes and pain in the thumb joints of physiotherapists.

Hand Position

The hand position used for the application of manual techniques is another technical factor that may affect the development of symptoms in the thumb joints of physiotherapists. When thumb pressure is applied during manual techniques, the placement of the thumb joints in relation to the point of thumb contact affects the joint compressive forces. If a thumb joint is placed further from a vertical line drawn through the point of thumb contact while pressure is applied, the joint compressive forces will increase in that particular joint (Figure 1). In a pilot study of four manipulative physiotherapy students, the force applied with the thumbs when performing a posterior-to-anterior spinal mobilization was measured with a force platform while photographs were taken of the subjects' hands. Mathematical analysis indicated that the magnitude of the joint compressive forces in the IP and MCP joints was increased the further that the center of the joint was from a vertical line drawn through the point of contact[16]. Therefore, the physiotherapist's hand position may influence the development of degenerative changes in the thumb joints, since certain hand positions may increase compression forces at the joints' articulating surfaces.

Potential detrimental hand positions may include those positions in which pressure is applied with the thumbs while the IP, MCP, or CMC joints of the thumb are placed horizontally further from the point of thumb contact (Figure 1). This type of hand position may be used to apply pressure to the transverse process of thoracic vertebrae when mobilizing the thoracic spine using a technique described by Maitland et al[6]. This hand position may also be used more frequently by those practitioners who have decreased passive hyperextension at the IP joint, since the stiff IP joint may cause the MCP and CMC joints to move away from the point of contact as the thumb pad contacts the patient. Manual therapy texts encourage the use of the thumb pad to apply pressure because patient comfort is increased[6]. The pad of the thumb is softer and has a greater surface area than the tip; therefore, the thumb pad distributes the pressure that is applied to the patient over a larger area, decreasing the intensity of pressure at any one point along the contact surface of the thumb pad. Thus, physiotherapists may feel that they should attempt to routinely apply pressure with the thumb pad to enhance patient comfort. In a physiotherapist with a stiff IP joint that lacks hyperextension, the application of pressure with the thumb pad may contribute to detrimental joint reaction forces in the thumb MCP and CMC joints because of their position relative to the point of force application.

The application of thumb pressure with the thumb joints situated further horizontally from the point of patient contact may also place undesirable forces on the MCP joint that encourage it to hyperextend (Figure 2). As a physiotherapist applies a downward force through the thumb, an equal and opposite force is generated back through the contact point of the thumb to the therapist. If the MCP joint is situated directly vertical over the point of thumb contact, then the resultant forces acting on the joint will also be vertical, and thus have no effect on forcing the joint in any direction (Figure 3). If the MCP joint is situated horizontally further from a vertical line drawn through the point of patient contact, the resultant forces acting on the MCP joint would force it into hyperextension if it were not for the stabilizing effect of muscles on the thumb. As previously discussed, MCP hyperextension is detrimental to both the MCP and CMC joints of the thumb. After extended periods of mobiliz-

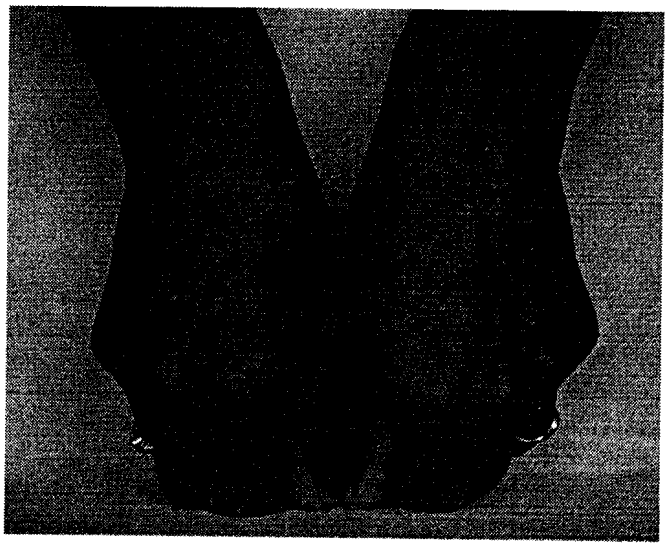

Fig. 3: Mobilizing position with thumbs supported, which prevents MCP hyperextension.

ing, the muscles that stabilize the thumb may become fatigued and no longer be able to adequately resist the forces that are pushing the MCP joint into hyperextension. If there is already some inherent instability at the thumb CMC joint, causing the metacarpal base to move dorsoradially and the MCP joint to hyperextend, it will be even more difficult for the therapist to hold the MCP joint stable while performing a downward thumb pressure. Therefore, it appears that the application of pressure through the thumbs with the base of the thumbs separated is a potentially detrimental hand position for the physiotherapist.

Physiotherapists are sometimes taught to apply thumb pressure with the IP and MCP joints of each hand approximating each other, with a flexed index finger bracing against each thumb for added support (Figure 3). It appears that this position may cause less stress on the thumb joints of the therapist but may be more uncomfortable for the patient, since the thumb tips are being used to apply pressure rather than the thumb pads. The effect of hand position used for manual techniques on articular stress in the thumb joints has not been investigated, so physiotherapists must rely on their own judgment to determine the hand position that is most comfortable for themselves and their patients, while maintaining the effectiveness of their manual treatment.

The direct effect of technical factors on the development of thumb pain in physiotherapists has not been determined, despite the fact that half of all physiotherapists surveyed in two studies felt that manual therapy, which may include various extreme hand positions and forces, was a risk factor for work-related musculoskeletal injury[2, 5].

Environmental Factors

Environmental factors relate to the work setting of the physiotherapist. Aspects of the workplace include the physical layout of the clinic, the types of clients and disorders treated, and the overall workload of the physiotherapist.

Physiotherapist's Worksite

The physical layout of the clinic includes the availability of adequate workspace, so that there is enough room around the treatment bed for a therapist to position herself properly for the delivery of a manual technique. The layout of the clinic should also reflect the number of therapists working at any one time, so that there is adequate treatment area and available height-adjustable beds for each therapist.

Ergonomic aids may also affect the therapist's ability to effectively administer manual treatments and could potentially lessen the risk of physical harm to the physiotherapist. Ergonomic aids include height-adjustable beds, step stools for adjusting the height of the therap when height-adjustable beds are not available, and ha tools for use when heavier pressure is desired. Hand to may include massage devices with firm wooden or pla tic knobs for applying pressure, or devices that are sp cifically designed to reduce the strain on the thumbs su as the Superthumb or Kneeshaw devices[46].

Client Volume and Workload

The types of clients and conditions treated by th physiotherapist will be largely related to the type of clini where the physiotherapist works (e.g., sports injury clinic pediatric clinic, chronic pain clinic, general orthopaedi clinic, etc.). The general size and bulk of a patient may have an effect on the level of force required by the physiotherapist in performing a manual technique. For example, a stiffer joint on a larger patient may require more force from the therapist to reach its end of range[39]. The proportion of clients who require manual therapy as a part of their treatment will also affect the amount of time that a therapist spends performing manual techniques.

The total number of manual therapy treatments a physiotherapist will regularly perform will also be influenced by the volume of clients. Client volume is determined by the frequency of appointments and the number of hours in the working week. Guidelines for physiotherapy practice have been suggested based on studies in other industries that indicate that scheduling a variety of tasks reduces risk of injury, but there are currently no standards that stipulate a specific workload that is appropriate for the physiotherapist[1].

Preventive Strategies

Reducing the risk of work-related thumb and hand injury in physiotherapists will potentially require a combination of preventive strategies. Interventions that have been proposed as conservative treatment in early first CMC joint arthritis may also be effective as preventive measures to delay the onset and slow the progression of degenerative changes in the thumbs of physiotherapists. These prevention strategies, which include splints, exercise, and modification of activities, may also be beneficial in treating the onset of early thumb symptoms in physiotherapists. Research is needed to determine whether any of these strategies are effective in preventing or treating thumb pain in physiotherapists.

Splints

Splinting to control dorsoradial translation of the metacarpal base has become standard treatment in the conservative management of early-stage first CMC joint osteoarthritis[24, 26, 28, 31, 34]. Splints that are custom-made for the individual are regarded as the most effective[24].

The splint should be designed so that the distal end of the first metacarpal is held away from the palm while allowing MCP and IP joint flexion, therefore preventing the base of the first metacarpal from moving dorsoradially[34]. A splint such as this can be worn by the physiotherapist while administering some manual techniques that require thumb pressure, such as spinal joint mobilization. The splint can potentially stabilize the CMC joint and reduce MCP hyperextension. However, the splint may be a hindrance while performing other techniques such as massage, where the palm of the hand is used more frequently.

The thumb strap splint stabilizes the thumb CMC joint,[35] and therefore may be beneficial in reducing physiotherapist discomfort when worn by the therapist while she performs manual techniques. Indeed, in our experience physiotherapists who have worn similar splints fabricated by hand therapists have anecdotally reported that they find the splints helpful in reducing discomfort while performing posterior-to-anterior spinal mobilizations with the thumb. Physiotherapists may also consider fabricating their own splints, which may incorporate the CMC, MCP, or IP joints. In one survey, 55% of physiotherapists with hand pain reported using splints or other orthoses to control their symptoms[5]. One author has proposed a splint for the IP joint to be used while performing posterior to anterior spinal mobilizations with the thumbs[47]. It is likely, however, that splinting the IP joint may cause increased stress to the thumb MCP and CMC joints. At this time, a universally recommended splint for use specifically by physiotherapists has not been developed.

Screening

Another proposed preventive strategy is the screening of physiotherapy students for evidence of joint hypermobility. Those with a tendency toward hypermobility could be made more aware of their inherent risk and be able to take additional precautionary measures. Education regarding the effects of increased thumb joint mobility on the application of manual techniques could be incorporated with education on manual handling techniques and body mechanics specific for the physiotherapist, with the goal of increasing student awareness of workplace risks. Physiotherapists are usually very good at educating their patients about work-related risks but may benefit from increased instruction regarding the application of ergonomic principles to themselves[1].

Exercise

Exercise is another aspect of intervention that has been proposed by several authors as important in the conservative treatment of thumb CMC joint osteoarthritis and pain[26,38]. Exercises that encourage increased stability in the thumb joints need to be very specific, since simple exercises that target grip and pinch strength can potentially aggravate symptoms if a muscle imbalance already exists at the CMC joint[38]. Recommended exercises recruit the abductor pollicis longus muscle, since it has been shown to function as a CMC joint stabilizer[32,36,38]. The recommended exercises consist of activities that maintain CMC joint extension while discouraging MCP hyperextension and encouraging expansion of the first web space[26]. Some examples are actively extending the thumb in a radial direction against resistance and abducting the thumb perpendicular to the palm against resistance[26]. When exercising, it is important to use proper alignment and avoid MCP hyperextension, since MCP hyperextension contributes to instability and degeneration of the CMC joint and may perpetuate thumb problems (Figure 4).

As strength progresses, functional activity can be initiated by practicing gripping and pinching activities while maintaining the thumb CMC joint stable with the MCP joint in slight flexion[38]. Functional activity for the physiotherapist might include the practice of a problematic mobilization technique while maintaining CMC extension, slight MCP flexion, and adequate stability at each of the thumb joints. However, it is not known if these types of exercises are effective as preventive measures to help physiotherapists maintain joint stability, particularly considering that the physical demands of physiotherapists' work may outweigh the effect of preventive exercise.

Techniques and Tools

Since so many physiotherapists report the performance of manual therapy as an aggravating factor for their hand symptoms, the manual therapy techniques that physiotherapists use should be investigated. Could certain techniques be causing the bulk of the problem? Or is it simply the volume of patients treated and the time spent administering manual therapy that causes pain in the thumb?

There has been very little research into the relationship between specific manual techniques and their effect on work-related musculoskeletal discomfort in physiotherapists. One survey that questioned 81 therapists about specific techniques found that the incidence of thumb pain was highest while performing mobilizations (79%) and massage (30%)[17]. The most common mobilization techniques that were avoided by therapists with thumb pain were transversely directed pressures to the spine and posterior-to-anterior pressures along the lateral edge of the spine. Both of these techniques potentially require substantial loading through the thumbs and have been described by Maitland et al[6].

Some individuals recommend the use of a tool for the application of spot pressures, rather than using the

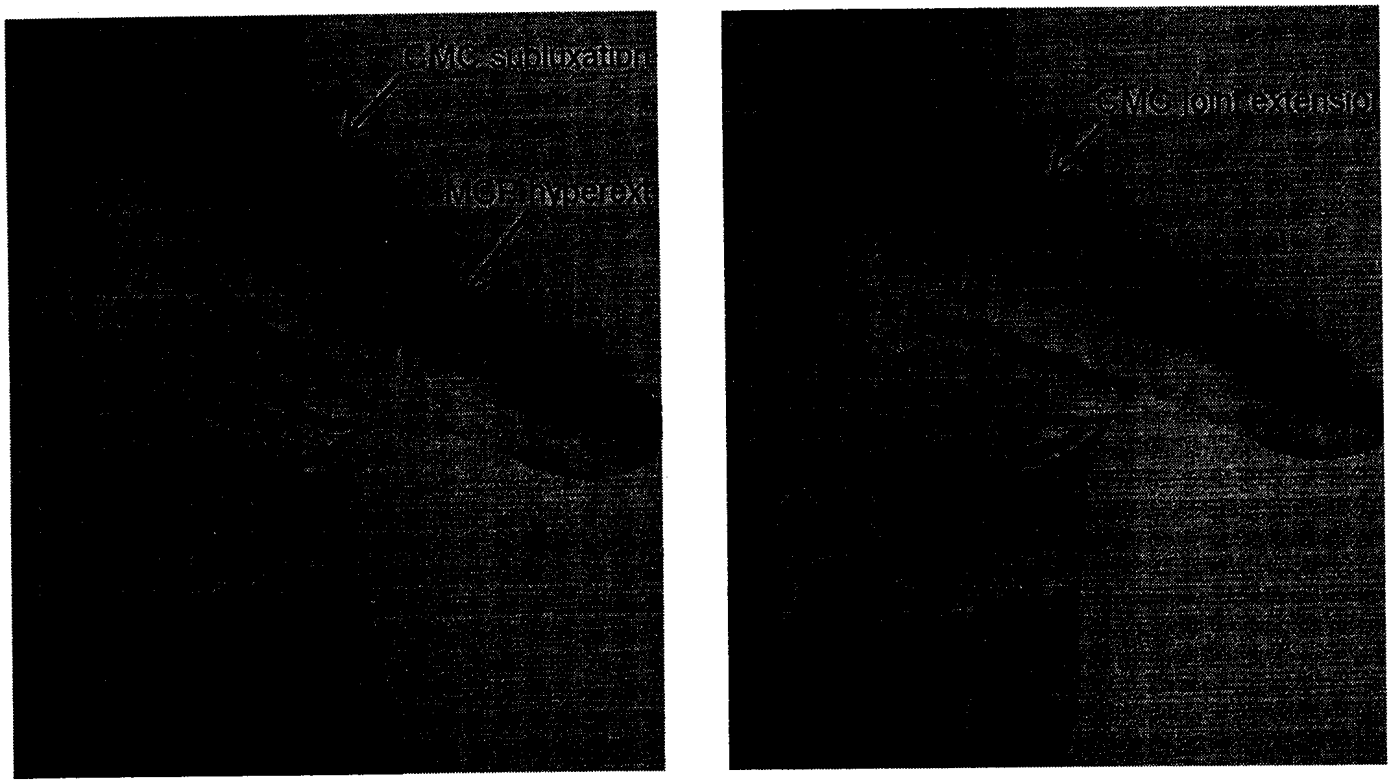

Fig. 4: Active thumb extension exercise. Left: Improper positioning with the MCP joint hyperextended, potentially causing dorsoradial subluxation of the base of the metacarpal. Right: Proper positioning with the MCP joint neutral and the thumb extending from the CMC joint.

thumb[46]. Certainly, this would be expected to take the stress off the thumb joints, but controlled trials of two tools currently on the market have revealed that physiotherapists do not find the devices comfortable or practical for use in the clinic when compared to an alternate hand position in which pressure is applied with the ulnar side of the hand in the region of the pisiform bone[46]. Perhaps comparison of the tools with thumb pressure would reveal a greater acceptance by physiotherapists, particularly if the therapist had existing thumb pain.

Research into the effect of the application of manual techniques on the physiotherapist may influence the future education of physiotherapists. Further investigation is needed to determine a level of risk for specific techniques and to develop recommendations for safe levels of exposure to manual therapy for the physiotherapist.

Conclusion

Work-related musculoskeletal pain in the thumb is becoming recognized as a widespread problem for physiotherapists who regularly apply manual therapy techniques. Predisposing factors inherent in the thumb of the physiotherapist and the workload demands of manual therapy may both contribute to the development of painful symptoms. Further research is needed in order to formulate sound recommendations for the prevention and treatment of work-related thumb and hand disorders in physiotherapists. ■

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